

### **REMARKS**

The Office Action of June 16, 2005 was received and reviewed. Applicants would like to thank the Examiner for the consideration given to the above-identified application.

Claims 1-3 and 6-14 and 19-48 were pending prior to the instant amendment. By this amendment, claims 1, 2, 3, 13 and 14 are amended. Claims 4-5 and 15-18 have been cancelled previously. Consequently, claims 1-3, 6-14 and 19-48 are currently pending in the instant application, of which claims 1-3, 13 and 14 are independent.

Referring now to the detailed Office Action, claims 1-3, 6-14, 19-43 stand rejected under 35 U.S.C. §103(a) as unpatentable over Yamazaki (U.S. Patent 4,727,044 – hereafter Yamazaki) in view of Silver (U.S. Patent 5,104,818 – hereafter Silver) and further in view of Chang (U.S. Patent 5,064,775 – hereafter Chang), Zhang et al. (U.S. Patent 5,904,509 – hereafter Zhang et al.) and Miyasaka (U.S. Patent 6,455,360 – hereafter Miyasaka).

Claims 44-48 stand rejected under 35 U.S.C. §103(a) as unpatentable over Yamazaki in view of Silver and further in view of Chang and further in view of Zhang et al., Miyasaka and Wolf et al. (“Silicon Processing for the VLSI Era Volume 1: Process Technology” – hereafter Wolf et al.). Each of these rejections is traversed for the reasons advanced in detail below.

Applicants’ remarks submitted in the Amendment filed May 5, 2005, which was subsequently entered by the filing of a RCE on June 3, 2005, are reiterated herein in response to the above-summarized rejections.

The present invention is distinguishable from the cited art of record by recognizing that ion-doping without mass separation can be used for adding an impurity to a channel region when using an impurity gas diluted with hydrogen at a concentration of 0.5 to 5%.

Yamazaki discloses that “in the formation of the semiconductor layer 2’, a concentration of oxygen, nitrogen, or carbon,..., is not contained therein a large amount exceeding  $5 \times 10^{18}$  atom/cm<sup>3</sup>...”. That is, Yamazaki appears to disclose the general matter of the concentration of a channel region. However, Yamazaki does not disclose a channel doping and an ion-doping without mass separation. Hence, Yamazaki does not recognize the problem relating to contamination of C, O, and N caused by ion-doping without mass

separation. Therefore, Applicants do not believe that the combination of Yamazaki, Silver, Chang, Wolf et al., Zhang et al., and Miyasaka leads to the present invention.

Specifically, Silver and Chang disclose an implantation of the channel region, Wolf discloses implantation through an insulating film, Zhang and Miyasaka appear to disclose ion-doping without mass separation, and Miyasaka appears to disclose diluting diborane with hydrogen at a concentration of 0.1 to 10%. However, none of them do recognize that there is a problem relating to contamination of C, O, and N caused by ion-doping without mass separation.

In the present invention, the inventors recognized that ion-doping with an impurity gas diluted with hydrogen at a concentration 0.1% has the problem that relating to contamination of C, O, and N due to a long doping time when the ion-doping is performed to a channel region. In addition, it is disclosed that ion-doping with the impurity gas diluted with hydrogen at a concentration of 10% is difficult to control because doping time is quite short. Based on these problems, the present invention discloses that ion-doping without mass separation can be used to channel region with little contamination of C, O, and N (claims 1, 2, 3) according to set a concentration of an impurity gas diluted with hydrogen at 0.5-5%, or hydrogen as recited in claim 13.

By recognizing the solution to the above problem of C, O and N contamination, unexpected results are obtained utilizing hydrogen at the claimed concentration, as explained in detail beginning on page 11 to the top of page 14 of the specification. More particularly, pages 13-14 of the specification indicates that results are significantly improved if the impurity element is diluted with hydrogen at a concentration of 0.5% to 5%. The results show that 0.1% more hydrogen atoms are added to the semiconductor layer, where 5% was deemed to provide very good results. Figures 1-3 also provide further evidence of the consistent level of C, O and N concentrations when the method of the present invention is employed.

Consequently, the cited art of record fails to teach or suggest the problems associated with the use of ion-doping for forming a channel region, particularly when using no mass separation. By providing an impurity element diluted with hydrogen at a concentration range of 0.5 to 5% when using ion-doping and no mass separation, a semiconductor device having

improved characteristics (claim 14) can be obtained, or more particularly, a device having a low concentration of C, O and N can be obtained (claims 1, 2, 3) or H (claim 13).

The requirements for establishing a *prima facie* case of obviousness, as detailed in MPEP § 2143 - 2143.03 (pages 2100-122 - 2100-136), are: first, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to combine the teachings; second, there must be a reasonable expectation of success; and, finally, the prior art reference (or references when combined) must teach or suggest all of the claim limitations. Without recognizing the problem the presently claimed invention is solving, and without the motivation or suggestion to combine the prior art references, a *prima facie* case of obviousness has not been established in the pending rejections.

Claims 1, 2, 3, 13 and 14 have been amended as shown above to further complete the scope to which Applicants are entitled.

In view of the foregoing, it is respectfully requested that the rejections of record be reconsidered and withdrawn by the Examiner, that claims 1-3, 6-14 and 19-48 be allowed and that the application be passed to issue. If a conference would expedite prosecution of the instant application, the Examiner is hereby invited to telephone the undersigned to arrange such a conference.

Respectfully submitted,



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